www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(9): 1821-1824

www.thepharmajournal.com
Received: 04-06-2022
Accepted: 13-07-2022

SA Jayalakshmi
M.Tech (PFE) Scholar, CAET, DBSKKV, Dapoli, Maharashtra, India

AA Sawant
Associate Professor, Department of PFE, CAET, DBSKKV, Dapoli, Maharashtra, India

KB Suresha
Associate Professor, AICRP on PHET, UAS, GKVK, Bengaluru, Karnataka, India

SB Kalse
Assistant Professor, Department of PFE, CAET, DBSKKV, Dapoli, Maharashtra, India

Corresponding Author:
SA Jayalakshmi
M.Tech (PFE) Scholar, CAET, DBSKKV, Dapoli, Maharashtra, India

Assessment of physiochemical, nutritional composition, and texture qualities of proso millet (*Panicum miliaceum* L.) Flakes

SA Jayalakshmi, AA Sawant, KB Suresha and SB Kalse

Abstract
Millets are the most important cereal grain and the most sustainable food source for the world's rising population. In terms of health advantages, it also outperforms rice and wheat. An experiment was conducted to investigate the potential of Proso millet (*Panicum miliaceum* L.) for the production of proso millet flakes. Proximate analysis of proso millet flakes was evaluated by the standard procedures of AOAC. Epidemiological studies have been shown that a rise in the consumption of proso millet and its products is associated with a reduced risk of chronic diseases, such as elevated serum cholesterol, cardiovascular disease, type II diabetes, and liver injury. The flakes were subjected to evaluation of their physio-chemical, nutritional, and textural properties. The proso millet flakes exhibited creamy white, small, thin, crispy, irregular shaped, dry, and light in weight. The bulk density and true density were 0.23 g/mL and 1.29 g/mL, respectively. The millet flakes had a water-holding capacity of 47.61% and a water absorption capacity of 161.02%. The millet flakes had moisture, fat, protein, total ash, crude fiber, and carbohydrates of 10.49, 0.52, 14.73, 1.24, 21.58, and 53.62 percent, respectively.

Keywords: Proso millet (*Panicum miliaceum* L.), millet flakes, physio-chemical, nutritional, and textural properties

Introduction

Millet is the world's fifth most important cereal, behind wheat, maize, rice, and barley. It is quite palatable, and the grains have been utilized in both conventional and advanced diets. Millet is high in protein, fibre, and essential vitamins and minerals. Millet has the ability to preserve cardiovascular health, reduce the onset of diabetes, assist people in achieving and maintaining a healthy weight, and manage inflammation in the gut. Millet is a tolerant grain. There are several simple methods to prepare it, making it simple for celiac patients to include this gluten-free grain into their diets. They are more nutritious, non-glutinous, non-acid-forming, and easily digestible (Nazni and Bhuvaneswari, 2015) [17]. It is a minor cereal with great nutrient quality, but its consumption is constrained, owing to a lack of ready-to-cook or ready-to-eat millet goods; nevertheless, millet processing to make RTC meals increases its economic and nutritional value (Devi and Sangeetha, 2013) [18].

Proso millet (*Panicum miliaceum* L.) germplasm collections have vast genetic variability and vary in kernel colour, size, shape, and other characteristics too. Traditionally proso millet Formulation and has been analysed on the basis of nutritional value, such as starch and crude protein contents, mineral contents. Proso millet is highly drought-resistant, which makes it of interest to regions with low water availability and longer periods without rain. Compared to all millets proso is a short-season crop, reaching maturity in 60 to 75 days after planting. It is most frequently grown as a late-seeded summer crop (Bhat *et al.* 2018) [19].

Breakfast cereal is a food product made from processed cereal grains and often eaten for breakfast. Breakfast cereal products were originally sold as milled grains that required further cooking in the home prior to consumption. In this century, due to efforts to reduce the amount of in-home preparation time, breakfast cereal technology has evolved from the simple procedure of milling of grains for cereal products that require cooking to the manufacturing of highly sophisticated Ready-to-Eat products that are convenient and quickly prepared (Adensina *et al.* 1989) [20]. Breakfast cereal can be said to be a ready-to-eat, ready-to-cook convenient food product. They include puffed, flaked, shredded, and granular products made from wheat, maize, oats, rice, millet, and barley. They may be enriched with sugar, honey, a malt extract and fortified with vitamins, minerals, and nutrients.

The advantages of having breakfast cereals are the higher intake of carbohydrates, micronutrients, total sugars and lower intakes of fat, cholesterol, lower serum cholesterol concentrations, greater likelihood of meeting micronutrient recommended intakes and nutritional status.

Materials and Methods

Proso millet was procured from the Zonal Agricultural Research Station, analysis carried out in AICRP on Post-Harvest Engineering and Technology and Centre of Excellence for Nutri-Cereals, UAS, GKVK, Bengaluru and the chemical analysis was carried out in the National Agricultural Innovation Project (NAIP) laboratory at CAET, DBSKKV, Dapoli's Department of Agricultural Process Engineering. Physical, chemical, functional and textural characteristics of proso millet flakes were assessed by following standard procedures

Physical characteristics

Volume was estimated by dropping 1000 randomly chosen grains into a measuring cylinder containing a known volume of distilled water. The volume difference was measured in ml. Bulk density was calculated by dividing weight of grain by volume of grain. The true density of the grain was calculated by dividing weight of the grains by Volume of grains excluding pore space. Porosity was calculated by bulk density by true density. The colour of randomly selected flakes and grains was evaluated and the results using a Spectrophotometer Konica Minolta, CM-2600/2500d model.

The water holding capacity was estimated by approximately 5 g of finely ground sample was weighed and rehydrated overnight in 35 mL of distilled water. After draining, it was weighed and recorded, and water holding capacity was estimated by subtracting the weight of the wet sample after draining from the weight of the dry sample (Deshpande and Poshadri, 2011) [7].

$$\text{Watern holding capacity (\%)} = \frac{\text{weight of wet sample after draining(g)} - \text{weight of dry sample(g)}}{\text{Weight of sample (g)}} \times 100$$

The water/oil absorption capacity was assessed by grinding the samples to a fine powder and placing them in a centrifuge tube with 30 mL of distilled water/ground nut oil. The material was allowed to stand for 30 minutes before being centrifuged at 1500 rpm for 30 minutes. The free water/oil mixture was decanted into a graduated cylinder and the volume was measured. The value was given in terms of grams of water/oil absorbed per gram of sample (Nawabueze, 2006) [14].

By employing a hot air oven maintained at 105 °C for 24 hours, the usual approach was used to determine the sample's moisture content (Association of Official Analytical Chemists).

$$\text{Moisture (percent)} = \frac{\text{Initial weight (g)} - \text{Final weight (g)}}{\text{Sample weight (g)}}$$

Using the micro kjeldhal method, the sample's protein content was examined according to the protocol (AOAC, 2005) [4].

$$\text{Protien (percent)} = \frac{\text{Titre valve} - \text{Normality of HCL} \times 14.007 \times 6.25}{\text{Sample weight (g)}}$$

The sample's fat content was assessed using the protocol's conventional solvent extraction method (AOAC, 1997) [4].

$$\text{Crude fat (percent)} = \frac{\text{Initial weight (percent)} - \text{Final weight (g)}}{\text{Sample weight (g)}} \text{x100}$$

The sample's ash composition was examined using the accepted technique of employing a muffle furnace (AOAC, 2005) [3].

$$\text{Ash content (percent)} = \frac{\text{weight of ash (g))}}{\text{Weight of sample (g)}} \times 10$$

Using a fiber extraction device, the conventional process was used to evaluate the crude fiber sample (AOAC, 1990) [2].

$$\text{Dietary fibre} = \frac{\text{Weight of residue (g)} - \text{Weight of dietary fiber (g)}}{\text{Sample weight (g)}} \times 100$$

Using a normal approach, the number of carbohydrates in the sample was calculated by deducting its total protein, fat, fiber, ash, and moisture content from 100. (AOAC, 1980) [1].

% Carbohydrates = 100 - (% Moisture + % Protein + % Fat + % Fiber + % Ash)

On the selection of breakfast cereal products, texture profile analysis of the samples was carried out using a texture analyser (TAXT2, Stable Micro Systems, Surrey, UK). The P50 compression probe was used to compress a single particle. The software Exponent (Stable Micro Systems, Surrey, UK) was used to evaluate the data after each measurement was made on 25 randomly selected flakes, and the average value was reported as g force.

Statistical analysis to assess the variation in the impact of processing on the physical properties, chemical composition, and textural features of proso millet flakes using the methods given, the evaluation of proso millet flakes was analysed using a factorial CRD 4x4x3.

Results and Discussion

Conventional batch processing methods were followed for the development of Ready to Cook or Ready to Eat Proso millet flakes. Process parameters for producing the little millet flakes were soaking (16 hours), cooking (85 °C for 10 minutes) and drying (40 °C for 1 hour) were found to be optimum for producing good-quality flakes. Millets are healthy nutrient sources; therefore, their name has become synonymous with health and well-being. The physical, Chemical and Nutritional composition of proso millet flakes is presented in Table 1.

Physical properties

The various physical characteristics of proso millet flakes were analysed and the results are presented in Table 1. It was observed that the proso millet flakes were creamy white, thin, irregular shaped, dry, light and crispy in colour. The mean value of colour of proso millet flakes L*, a* and b* is 77.89, 1.61 and 17.06 with critical difference (CD) of 5.98, 0.12 and 1.31. The mean value of flake volume was 4.32 mL with CD of 0.33. The mean value of bulk density and true density proso millet flakes was 0.23 and 1.29 g/mL with CD of 0.23 and 0.10. There was no heterogeneity between all the physical properties with respect to CD. Physical characteristics are extremely significant in analysing its process ability. The present results of this analysis on the physical properties of proso millet RTC flakes are consistent with Takhellambam *et al*. 2015 [12]. Colour is an essential quality characteristic that is closely related to the acceptance of food products. Bulk density is the gold benchmark for high flaking quality. As a result, proso millet flakes had reduced bulk density. The physical properties of proso millet flakes were comparable to those of roller dried foxtail millet flakes (Singh *et al*. 2004) [15].

Proximate composition of proso millet flakes

The nutrient composition of proso millet flakes is presented in Table 4.1. It noticed that moisture, protein, fat, total ash, crude fiber and carbohydrate of proso millet flakes were in the range of 10.31-10.69, 14.70-14.76, 0.45-0.59, 1.19-1.29, 21.41-21.71 and 53.5-53.7% respectively. Proso millet flakes observed significantly less amount of protein, fat, fiber, ash and carbohydrates when compare to grain. The mean value of moisture, protein, crude fat, total ash, crude fibre and carbohydrates of proso millet flakes was observed to be 10.49, 14.73, 0.52, 1.24, 21.58 and 53.62% respectively. The composition of proso millet flakes with respect to its nutrient content is very much needed to decide on its possible utility. Similar results were obtained from the studies of Takhellambam *et al.* (2015) [12] for proso millet flakes.

Functional characteristics of proso millet flakes

The functional characteristics of proso millet flakes are presented in Table 1. Water holding capacity and water absorption capacity obtained mean values of 47.61 and 161.02 percent, respectively. Functional characteristics are crucial factors that determine the final application, both during processing and during the production of various products with added value. Similar results were found in soy flakes, according to Bargale *et al*. (1991) [21].

Table 1: Physical, chemical and functional properties of proso millet flakes

Sl. No.	Parameters	Range	Mean	S.Em±	CD (5%)
	Physical properties				
1	**Descriptive characteristics**	**creamy white, small, thin and crispy, irregular shaped, dry and light in weight**			
2	Colour *L**	76.5-78.63	77.89	1.97	5.98
	*a**	1.59-1.64	1.61	0.04	0.12
	*b**	17.03-17.08	17.06	0.43	1.31
3	Bulk density (g/mL)	0.22-0.26	0.23	0.01	0.23
4	True density (g/mL)	1.25-1.35	1.29	0.03	0.10
5	Volume (mL)	4.29-4.35	4.32	0.11	0.33
6	Porosity	0.80-0.824	0.821	0.01	0.03
	Functional Properties				
7	Water holding capacity (%)	42.11-53.62	47.61	1.19	3.60
8	Water absorption capacity (%)	159.3-162.1	161.02	4.06	12.33
	Chemical Properties				
9	Moisture (%)	10.31 -10.69	10.49	0.26	0.80
10	Crude protein (%)	14.70-14.76	14.73	0.37	1.13
11	Crude fat (%)	0.45-0.59	0.52	0.01	0.04
12	Total ash (%)	1.19-1.29	1.24	0.03	0.10
13	Crude fiber (%)	21.41-21.71	21.58	0.54	1.65
14	Carbohydrate (%)	53.5-53.7	53.62	1.35	4.11

L* indicates black to white

a* indicates redness to greenness and

b* indicates yellowness to blueness

Textural attributes of proso millet flakes: The various textural attributes of optimized proso millet flakes were analysed. The values of hardness, fracturability, springiness, cohesiveness, gumminess chewiness and resilience along with the area under curve is presented for proso millet flakes. The force time at different peaks and area obtained for the compression test of selected flakes are presented in Table 2. The analyser also shows the graphs obtained during the actual test run of compression tests. The mean force required to break the flakes was 3976.302g with a CD of 5.16. The mean value of fracturability (g), springiness, cohesiveness, gumminess, chewiness and resilience were recorded to be 85.61g, 0.202, 0.772, 2394.09, 4769.79 and 2.28 with CD of 6.57, 0.02, 0.06, 6.80, 6.43 and 0.17, respectively.

Table 2: Textural attributes of optimized flakes

Sl. No.	Textural attributes	Value	S.Em±	CD	F-test
1	Hardness (g)	3976.302	1.70	5.16	*
2	Fracturability (g)	85.61	2.17	6.57	*
3	Springiness	0.202	0.01	0.02	*
4	Cohesiveness	0.772	0.02	0.06	*
5	Gumminess	2394.09	2.24	6.80	*
6	Chewiness	4769.79	2.12	6.43	*
7	Resilience	2.28	0.06	0.17	*

References

1. AOAC. Official Methods for computation of carbohydrates and energy. Association of Official Analytical Chemists. 14th Edition. Washington, D.C. USA; c1980.
2. AOAC. Official Methods of Analysis for ash, moisture in flour. Association of Official Analytical Chemists; 18th Edition. Arlington VA 2209, USA. AOAC 929.09 & 03, chap 32. c2005, 1-2.
3. AOAC. Official Methods of Analysis for crude fiber. Association of Official Analytical Chemists. 15th Edition. Washington, D.C. USA; c1990.
4. AOAC. Official Methods of Analysis for fat (crude) or ether extract in flour. Association of Official Analytical Chemists; 16th Edition. 3rd Revision. Gaithersburg, Maryland 20877-2417. AOAC 920.85, chap 32. c1997, 5.
5. AOAC. Official Methods of Analysis for protein. Association of Official Analytical Chemists. 18th Edition. Arlington VA 2209, USA. AOAC 984.13, chapter 04. 2005, 31.
6. Coulibaly A, Kouakou B, Chen J. Extruded adult breakfast based on millet and soybean: nutritional and functional qualities, source of low glycemic food. J Nutr Food Sci. 2012;2(151):2. http://dx. Doi.org/10. 4172/2155-9600.1000151.
7. Deshpande HW, Poshadri A. Physical and sensory characteristics of extruded snacks prepared from Foxtail millet based composite flours. Int. Food Res. J. 2011;18:751-756.
8. Devsetti R, Sreeama NY, Bhattacharya S. Nutrients and antinutrients in foxtail and proso millet milled fractions: Evaluation of their flour functionality. Food Science and Technology. 2014;59(2):889-895.
9. Gopalan C, Ramshatri BV, Balasubramanian SC. Nutritive value of Indian foods. Nat. Institute Nutri. 2010;24(2):1-48.
10. Gulati P, Weier SA, Santra D, Subbiah J, Rose DJ. Effect of feed moisture and extruder screw speed and temperature on physical characteristics and antioxidant activity of extruded proso millet (Panicum miliaceum) flour. International Journal of Food Science and Technology. 2016;51(1):114-122.
11. Itagi S, Naik R, Bharati P, Sharma P. Readymade foxtail millet mix for diabetics. Int. J Sci. Nature. 2012;3(1):4750.
12. Ranjita Takhellambam, Bharati V Chimmad. Study on physico-functional and nutrient composition of ready to cook (rtc) millet flakes. Asian journal of home sci. 2015;10(2):111-115.
13. Lenkannavar R. Development and quality evaluation of barnyard millet flakes. MHSc. Thesis, Univ. Agric. Sci. Dharwad (India). 2010.
14. Nawabueze T. Water/oil absorption and solubility indices of extruded African bread fruit blends. J Food. Technol. 2006;4(1):64-69.
15. Singh RU, Latha S, Malleshi NG. The functional properties of popped, flaked, extruded and roller dried, c2004.
16. Ushakumari SR, Malleshi NG. Physico-chemical characteristics, nutritional quality and shelf life of pearl millet-based extrusion cooked supplementary foods. Int. J Food sci. Technol. 2007;58(5):350-362.
17. Nazni P, Bhuvaneswari J. Analysis of physico chemical and functional characteristics of finger millet (*Eleusine Coracana* L.) and little millet (*P. Sumantranse*). International Journal of Food and Nutritional Sciences. 2015 Jul 1;4(3):109.
18. Devi RS, Kannan VR, Nivas D, Kannan K, Chandru S, Antony AR. Biodegradation of HDPE by Aspergillus spp. from marine ecosystem of Gulf of Mannar, India. Marine pollution bulletin. 2015 Jul 15;96(1-2):32-40.
19. Bhat G, Johnander J, Danelljan M, Khan FS, Felsberg M. Unveiling the power of deep tracking. In Proceedings of the European Conference on Computer Vision (ECCV). 2018, p. 483-498.
20. Adesina SK, Reisch J. Amides from Zanthoxylum rubescens. Phytochemistry. 1989 Jan 1;28(3):839-42.
21. Billore SD, Bargale MR. Effect of sources of phosphorus on growth and yield of two chickpea cultivars grown under different fertility levels. Indian J Plant Phys. 1991;34(1):48-53.